Descriptions of Courses

STE505 Semiconductor Process Laboratory
This laboratory course is designed to equip students with hands-on experiences about semiconductor processes by fabricating MOS transistors. Students will learn how to use cleanroom and do oxidation, photolithography, etching, diffusion, and thin film deposition processes. Measurement and analysis of the fabricated MOS transistors will also be practiced.

STE605 Semiconductor Memory Devices and SoC Designs
A main purpose of "Fundamentals of Memory Devices" is to provide a pn-junction theory, basic structures and operational principles of MOSFET to students at the outside as well as the inside of the Electrical Engineering department. Thereafter, cell structures and operational principles of DRAM, SRAM, Flash Memory, emerging transistors, and emerging memory devices will be introduced and reviewed comprehensively. Finally, this class will help students have chance to look outskirts of state-of-the-art researches of memory device and understand them. It is instructed by This is managed and instructed by professors at KAIST and executive directors at Samsung electronics.

EE571 Advanced Electronic Circuits
This course introduces new analysis methods for analog-circuits implemented by using bipolar and MOS transistors. Since the design of analog circuit requires both approximation and creativity, this course explains how to approximate and design complicated circuits. (Prerequisites: EE206, EE301)

CBE473 Microelectronics Processes
Unit Operations in micro-electronics processing such as chemical deposition, oxidation, ion implantation, metal sputtering, sputtering, chemical deposition process are introduced and how these unit processes are integrated to produce semiconductor chips. Especially, chemical engineering principles are focused on.

CBE525 Molecular Electronics
This course covers molecular electronic in organic materials, molecular methodologies, bio-optoelectronics and molecular electronic logic and architecture. Detailed topics includes molecular scale electronics in nano-science, foundations and theories of molecular electronics, properties and ordering of materials, piezoelectric and pyroelectric materials, molecular magnets, molecular nonlinear optics, photochromism, conducting polymers, charge transfer complex, OLED, liquid crystals and devices, self-assembly, Langmuir-Blodgett films, organic molecular beam epitaxy, molecules at surface, biological membrane, biosensors, biomolecular optoelectronics, molecular imaging, molecular electronic logic and architecture

CBE581 Micro-Chemical and Biomolecular Systems
The microfabrication principles for micro chemical and biomolecular systems composed of microfluidic reactors, lab-on-chip and nanometer and micron scale devices are discussed as well as the application examples.

CBE682 Organic Nano-Structured Materials
This lecture includes: non-crystal, crystals, liquid crystals, imperfections in ordered media, and finally nano-structure. Because the properties of nanomaterial are structure-sensitive, numerous associations in this class will be made to establish structure-property relations for advanced organic materials using very useful experimental techniques, in particular, diffraction and microscopy. Applications to IT and BT devices using nanostructured materials are also discussed.

CBE773 Recent Topics in Chemical & Biomolecular Engineering
This course offers opportunities to understand new theory and applications of chemical and biomolecular engineering. Details of the topics are announced at the beginneing of the semester.

CH471 Introduction to Polymer Chemistry
This course is designed to introduce polymer chemistry at the advanced undergraduate level for students with a background in organic chemistry. Topics include: concepts of polymerization reaction mechanisms, kinetics and stereochemistry. Prerequisites by topic: Organic Chemistry I

CH671 Organic Chemistry of High Polymers
This course is designed to give graduate students in Chemistry a survey of the synthesis and reactions of organic polymers and their physical characterization including kinetics of radical species and condensation polymerization, stereochemistry of polymers, ionic polymerizations and other organic chemistry of polymers.

CH672 Polymer Physical Chemistry
This course involves thermodynamic analysis of structure and properties of polymer systems. The focus here is on polymer structure, thermodynamics of polymer solutons, elasticity of rubber, phase equilibrium, friction, and transport processes.

CH674 Organic Electronic Materials
The course provides the basic principles, various organic and polymeric materials as well as their syntheses and the device fabrications of organic thin-film transistor, organic light-emitting diode and organic photovoltaic cell which are strongly connected with industrial fields.

CH675 Introduction to Lithography
Lithography is applied widely to manufacturing of semiconductor microchips, displays, and MEMS devices. This course discusses the physics of lithographic process, resist materials, resist processing, and emerging lithographic technologies such as nanoimprint lithography, interference lithography, immersion lithography, and scanning probe lithography.

CH774 Special Topics in Polymer Chemistry II
This course involves an in-depth study of molecular weight distribution, degrees of freedom, structural regularity, determination of micro-structures, and the relationship between chemical structure and polymer properties.

EE421 Wireless Communication Systems
This course emphasizes practical implementation aspects of digital communication systems. A physical-layer software implementation project will be assigned for a selected commercially-deployed communication system. Topics include digital modulation / demodulation in fading channel, channel coding, equalization and synchronization techniques.
(Prerequisite: EE321)

EE432 Digital Signal Processing
This course studies the representation, analysis, and design of discrete-time signals and systems. Topics include a review of the z-transform and the discrete Fourier transform, the fast Fourier transform, digital filter structures, digital filter design techniques, analog-to-digital and digital-to-analog data conversion, rate conversion, sampling and aliasing issues.
(Prerequisite: EE202)

EE511 Computer Architecture
The goal of this course is to understand the principles and organization of computer systems, and to learn the performance enhancing techniques and quantitative analysis methods used in advanced processors. This course covers high-performance techniques such as pipelining and out-of-order processing, memory hierarchy including cache memory and virtual memory, interrupt processing, and how to design a processor based on quantitative analysis. In addition, recent important topics such as SIMD and multiprocessors will be introduced and a design and simulation for a virtual processor is to be practiced for a comprehensive understanding of computer systems.
(Prerequisite: EE203, EE312)

EE535 Digital Image Processing
This course deals with the fundamental concept of digital image processing, analysis, and understanding. Topics include sampling, linear and nonlinear operations of images, image compression, enhancement and restoration, reconstruction from projections, feature extraction, and image understanding.

EE561 Introduction to VLSI Devices
This course covers fundamental VLSI device physics for graduate students. After a brief review of basic quantum mechanics and semiconductor processes, the lecturer will cover basic principles of operation in semiconductor devices including PN junction, MOS Capacitor, MOSFET and bipolar transistors with a strong emphasis on deep submicron secondary effects of MOSFET and bipolar transistors for extensive understanding of advanced device

engineering.
(prerequisite: EE461)

EE566 MEMS in EE Perspective
In this course, we will discover microelectromechanical systems (MEMS) in electrical engineering perspective, touching a complete set of design, fabrication, and applications. With respect to designing MEMS, we will explore various working principles, CAD tools including semiconductor design tools, and signal processing circuits. Also, core semiconductor processing technologies and a wide range of micro-machining techniques are studied in depth, in order to fabricate MEMS. We will address important issues in major fields of MEMS applications, including microsensors, RF / microwave, optical, and bio / microfluidic MEMS, specially in an electrical engineering viewpoint.

EE573 Introduction to VLSI Systems
This course covers the role, application and various issues in the design and verification of various VLSI chips including SoC (System-on-Chip). Additional topics include HW / SW co-design and co-verification, full-custom design, reconfigurable systems, low-power system, interconnection and packaging, clock distribution, VDSM (Very Deep Submicron) issues. Students will be given two opportunities for poster and oral presentations, respectively, on the topic of his / her choice within the course subject.

EE641 Monolithic Microwave Integrated Circuits
Key elements of microwave ICs for wireless systems including mobile communications are covered. Subcircuits for MMIC, MMIC design methods, Various integrated circuits, and measurement method are studied based on Si and compound semiconductor foundries. (Prerequisite: EE204, EE206)

EE661 Solid State Physics
This course is for graduate students. The course will cover basic concepts in solid state physics including solid structures, symmetry, reciprocal space, lattice dynamics, electrons in metals, semiconductors, dielectric and magnetic properties of both bulk solids and nano-structure.

EE663 High Frequency Electronic Devices
This course aims to give an understanding of the fundamental principles and technological developments in high-frequency electronic devices for microwave and high-speed digital / analog electronic systems and applications. (Prerequisite: EE461)

EE665 CMOS Front-End Process Technology
This module covers essential process steps in CMOS IC fabrication, focusing on front-end process technology including gate module, shallow junction module, thin film deposition, interconnection, and patterning technology. The students also develop understanding on physical background of each unit process as well as integration issues in modern CMOS devices. Recent developments on front-end processing are also covered.

EE676 Analog Integrated Circuits
This course deals with advanced level of analog circuits emphasis on CMOS. The topics include wideband operational amplifiers, comparators, Switched capacitor filters, ADC, DAC, continuous time filters, etc. (Prerequisite: EE571)

EE678 Digtal Integrated Circuits
This course is designed to expose students to the important issues in high performance CMOS circuit design. This course covers the data path design in full custom design methodology, clocking strategy, and the state-of-the art CMOS logic styles.

EE762 Advanced MOS Device Physics
This course will cover advanced device physics of MOSFETs and their ultimate scaling. Recent trends such as a new device structure and a new material will be introduced, and various types of memory devices as an example of detailed applications are also covered. Through a depth of study in quantum effects, reliability issues, and modeling, this course can provide core knowledge of next device technologies and a chance to explore new applications.
(Prerequisite: EE461, EE561)

MS613 Solid State Physics
This course is designed for beginning graduate students of materials science and engineering. It will cover crystal structure, lattice vibration, the theory of electron gas, the quantum electron theory and the concept of band theory.

MS635 Semiconductor Integrated Process Design
Since unit processes for VLSI manufacturing are related to each others, it is necessary that semiconductor engineers have a deep understanding about issues between the VLSI process integration and device operation. This course provides basic science underlying unit process steps, particular engineering in achieving required device performances, and the tradeoffs in optimizing device performance and enabling manufacturing. It assumes that the student has already acquired an introductory understanding of the semiconductor device physics.

MS642 Electronic Packaging Technology
This course covers electronic packaging technologies such as electronic design, thermal consideration, mechanical design, reliability and failure mechanism, chip interconnection, chip packaging, printed board technology, soldering, ceramic packaging, and multi chip packaging.

MS654 Surface Science
This course treats physical and chemical properties of surfaces and interfaces of material and interactions of electrons and photons with material surfaces, and describes modern scientific tools to obtain information about composition, structure and chemistry of surfaces on a microscale, such as, AES, XPS, FTIR, LEED, RBS, SIMS, EPMA, Raman spectroscopy, etc.

MS684 Principles of Semiconductor Devices
This course covers the basic physics, operation principles, and processes of semiconductor devices. This course provides the thinking tools for materials scientist to develop or improve the device characteristics, which are closely related to materials science such as structures, bulk defects, interface defects, thermodynamics, and kinetics.

MS696 Special Topics in Advanced Materials I
This course surveys, in depth, emerging technologies and advanced fields in materials science and their applications at graduate levels. This course offers guest lectures by staff and visiting specialists; this series forms a content that is integrated and on important aspects of the field.

PH441 Introduction to Plasma Physics
This course is designed to help students build their ability to understand basic plasma concepts. Topics include discharge processes and application of plasmas, motion of charged particles in electric and magnetic fields, plasmas as fluids (magnetohydrodynamics), diffusion in weakly and fully ionized plasmas, waves in fluid plasmas, and kinetic theory and nonlinear effects.
Topical Prerequisite: Electromagnetism

PH612 Advanced Solid State Physics II
This course follows the course Advanced Solid State Physics I, and is intended to provide graduate students in physics, chemistry, electrical engineering, and materials science with a graduate-xlevel understanding of advanced topics in solid state physics. Topics include: Optical properties, Elementary excitations, Electron correlations, Many body effects, Green's functions, Density functional theory, Magnetism, Superconductivity, and Nonlinear phenomena. (Prerequisites: PH503 and PH504.)

PH613 Semiconductor Physics
This course is designed to provide graduate students in physics, chemistry, electrical engineering, and materials science with an ability to understand the scientific and technological backgrounds of semiconductors and related devices. Topics include: electronic structure and optical properties of semiconducting materials, defects and impurities, electron transport, electron/optical devices and device structures.
Topical Prerequisites: Schrödinger equation and Hamiltonian, crystal structure and lattices, Boltzman and Fermi-Dirac distributions, Bloch theorem. (Prerequisites: PH611 and PH612)

PH621 Advanced Wave Optics
This course is designed to convey basic and advanced ideas concerning wave optics including Interference and diffraction theory, Temporal and spatial coherence, Fourier optics, Statistical optics, and the Theory of image

formation. Application of electromagnetic theory on thin film technology, Laser oscillator and crystal optics are also dealt with.
Recommended Prerequisites: PH391 and PH392 (Optics I, II)

PH643 Applied Plasma Physics
This course is intended for graduate students in Physics and other Engineering Departments. This course will start with six chapters of background information on plasma science relevant to industrial plasmas, followed by three chapters on ion, electron, and plasma sources which are common to many industrial applications. We will cover chapters on plasma processing of materials, and on plasma related applications and devices of industrial interest.

STE998 MS. Internship
In order to meet the requirement of the Semiconductor Technology Education Program (STEP), the M.S. degree candidates should participate in the internship program, which is held in the summer course during 4 weeks at the Samsung Electronics Co, Ltd. The objective of the course is to equip students with the research ability of practical tasks in the field of the semiconductor technology.

STE999 Ph.D Internship
In order to meet the requirement of the Semiconductor Technology Education Program (STEP), the Ph.D. degree candidates should participate in the internship program, which is held at the Samsung Electronics Co, Ltd. The objective of the course is to equip students with the research ability of practical tasks in the field of the semiconductor technology.

STE960 M.S. Thesis Research

STE980 Ph.D. Thesis Research